Syllabus

1 CAAM 502, Analysis II, Spring 2015

2 Instructor: William W. Symes, 2009 Duncan Hall, symes@rice.edu

3 Class meetings: Mech Lab 254, 10:50-12:05 TuTh. Office hours: by appointment

4 Content: calculus in vector spaces, including definition of the derivative as a linear map, the inverse and implicit function theorems, multivariate integration, the change of variables formula, and if time permits a basic treatment of some version of Stokes' Theorem.

5 Grade policy: course grade will be based on homework and class participation. Two pledged homework assignments will each contribute 15% to the grade; eight (or so) other homeworks will contribute 55%; class participation, as assessed by the instructor, 15%.

6 Absence policy: since class participation is an important element of this course, absences should be avoided, and whenever possible approved by the instructor ahead of time.

7 Main Texts:
   a. *Undergraduate Analysis*, Serge Lang, 2nd edition, Springer, New York, 1997.
   b. *Calculus on Manifolds*, Michael Spivak, Westview Press, New York, 1965.
   c. Many other resources exist, for example Rudin's *Principles of Mathematical Analysis*, Boyden's *Real Analysis,* Apostol's *Advanced Calculus*, and many other texts, also print and online notes sets and even MOOCs. Creative use of other resources will have a positive influence on the grade, but more importantly make the course more productive and interesting for the student.

8 Goals: upon completion of this course, students should demonstrate
   a. Understanding of the derivative as a linear map
   b. Facility with linear approximation and related estimates
   c. Application of the contraction mapping principle
   d. Riemann integration in several dimensions
   e. Understanding of measure zero, content zero, and Jordan measurability
   f. Meaning of Change of Variables theorem, proof by linear approximation

9 Outcomes: upon completion of this course, students will be able to
   a. Recognize role of derivative as linear map and manipulate derivatives via their Jacobian matrices;
   b. Master and create arguments based on local linear approximation and related error estimates;
   c. Use the Inverse Function Theorem to establish local existence of solutions to systems of equations
   d. Use the Implicit Function Theorem to establish the local existence of implicit functions
   e. Apply the key concepts of Riemann integration, in particular approximation by upper and lower sums, measure zero and content zero, and the Lebesgue Theorem on the

Riemann Integral;

f. Use Fubini's Theorem and the Change of Variables Theorem to compute multidimensional integrals
g. Apply the Theorem on Differentiation under the Integral Sign

10 Topics:

i. Definition of the derivative, partial derivatives, representation by Jacobian matrix, infinite dimensional examples, Mean Value Theorem
ii. Contraction mapping principle, inverse function theorem, implicit function theorem, other applications
iii. Partitions of rectangles, Riemann integration via upper and lower sums, negligible sets, Jordan-measurability
iv. Fubini's theorem and applications
v. Differentiation under the integral sign
vi. Volume of rectangle image under linear map
vii. Change of Variables theorem
viii. If time permits, introduction to the exterior calculus and Stoke's theorem

11 Coursework policy: Students are encouraged to work together on non-pledged assignments – however each assignment should be written up separately. Pledged assignments are subject to the Rice Honor Code. To receive full credit, assignments must be turned in on the due date. Late assignments turned in within a week of the due date will be downgraded by 20%. Assignments will be accepted later than one week only by prior arrangement with the instructor. The published volume of solutions to the problems in Lang *may not* be consulted or used in any way, for any part of this course.

12 Prerequisite: CAAM 501 and consent of the instructor. This course is required for first-year CAAM graduate students, and offers preparation for the analysis qualifying exam.

13 Any student with a disability that requires accommodation should contact both the course instructor and Disability Support Services in the Allen Center.

14 Information contained in this syllabus, other than the absence policies, may be subject to change with reasonable advance notice, as deemed appropriate by the instructor